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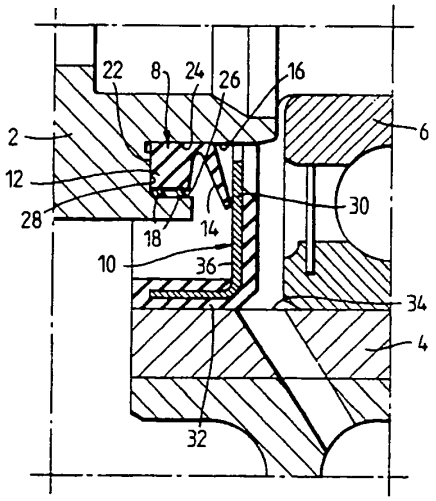
(54) A sealing device for sealing an annular space between two machine elements which are rotatable in relation to each other.

(57) A sealing device for sealing an annular space between two machine elements (2, 4) rotatable in relation to each other, comprising an elastic material sealing ring (8) and a counterface (36) engaged by a sealing lip (14) of the sealing ring. The sealing ring (8) has a main body (12) received in a groove (22) in one of the machine elements (2). The main body (12) of the sealing ring has at at least one of two side surfaces of the groove (22) at least one annular projection (18) engaging the opposite side surface of the groove.

Fig.1.



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The present invention relates to a sealing device for sealing an annular space between two machine elements which are rotatable in relation to each other.

A previously known sealing device of this kind comprises an elastic material sealing ring consisting of a main body sealingly and unrotatably connected with one of the machine elements and a sealing lip unitary with the main body and contacting a counterface unrotatably supported by the other machine element, the sealing lip sliding against said counterface when the machine elements are rotated in relation to each other.

In a common type of sealing device of the above kind the sealing ring consists of a substantially cylindrical, tubular main body to which the sealing lip is connected at the inner periphery of one of the side surfaces of the main body forming a V-shaped groove between the main body and the sealing lip.

In a previously known sealing device of this kind it is known to mount the sealing ring on a cylindrical surface, for example a shaft, and to lock the sealing ring in relation to said counter surface by means of the elastic main body. Prior to the mounting of the sealing ring on the cylindrical surface the main body has an inner diameter which is substantially smaller than the outer diameter of the cylindrical surface which means that the main body of the sealing ring will be in a tensioned condition on the cylindrical surface when the ring has been mounted thereon. The lip of the sealing ring has a predetermined axial compression in relation to the counter surface providing a relatively small lip pressure against the counterface.

When using sealing devices of the kind mentioned above in the region of the bearing arrangement for the two machine elements which are rotatable in relation to each other in for example a washing machine the sealing device has the object of preventing introduction of for example a solution of water, detergent and textile fibres to the bearing by the grip of the main body of the sealing ring on the cylindrical surface on which the sealing ring is mounted, the sliding and rubbing contact between the lip and the counterface and by the static seal between the counterface and the housing in which the bearing is arranged. Partly due to the introduction of fluid detergents which may have a swelling effect on the elastic material of the sealing ring and partly due to oxidation of the surface on which the sealing ring is mounted and which for example can consist of aluminium it has become common practice to arrange the main body of the sealing ring in an annular groove in the first machine element. By taking this precaution the problems caused by swelling and oxidation have been eliminated. However, the positioning of the main body of the sealing ring in a groove leads to some manufacturing problems due to more stringent tolerance requirements and mounting problems because of the fact that air is entrapped in the annular groove when the sealing ring is being mounted therein.

An object of the present invention is to obviate the above problem in sealing devices of the kind in question in which the main body of the sealing ring is positioned in a groove.

In order to comply with this object the sealing device according to the invention is characterized in that the main body of the sealing ring has at at least one of two side surfaces of the groove an annular projection engaging the opposite side surface of the groove.

Thereby the projection can be formed by an elastically flexible sealing lip.

When the sealing ring is being mounted in the annular groove air which is entrapped behind the main body of the sealing ring can pass the radial projections so that the inner surface of the main body of the sealing ring can reach a position in which the bottom surface of the annular groove is contacted thereby. This provides for a correct positioning of the sealing ring in relation to the machine element supporting the sealing ring and in relation to the counterface.

The provision of said projections on the main body of the sealing ring relaxes the tolerance requirements with regard to the annular groove as well as with regard to the main body of the sealing ring to practically feasible and economic levels.

There is another problem when using sealing devices of the kind mentioned above in machines in which there is a high rotational speed between the machine elements, which is the case for example in washing machines during the spin or centrifugation cycle. This problem is represented by the fact that the temperature of the counterface is because of the friction of the sealing lip at high rotational speeds raised to high values causing damages to or destruction of the sealing lip.

Another object of the invention is to obviate the last-mentioned problem.

In order to comply with this object the sealing ring according to the invention comprises an element which is unrotatably supported by the second machine element and comprises a part consisting of rigid material, preferably metal, and forming said counterface and an elastic material part connected with a part constituting the counterface and the other machine element and positioned between said part and said machine element, the elastic material consisting of a graphitic nitrile rubber preferably containing at least 20 % graphite by weight.

By the inclusion of graphite in the elastic material the heat transfer properties of the element forming the counterface is enhanced so that the

frictional heat created by the sliding of the lip against the counterface is led away in a more efficient way.

An embodiment of the invention is described in the following with reference to the accompanying drawings.

Fig. 1 is an axial section of one half of a sealing device according to the invention assembled in a washing machine.

Fig. 2a is an axial section of a profile of a sealing ring included in the sealing device according to fig. 1.

Figs. 2b and 2c are axial sections of modified embodiments of sealing rings corresponding to the sealing ring of fig. 2a.

In fig. 1 reference numeral 2 relates to a machine element constituted by a shaft rotatably supported in a washing machine by means of a second machine element constituted by a stationary part 4. The shaft 2 is rotatably supported by the stationary part 2 by means of a bearing 6.

The bearing 6 is protected from water, detergents, textile fibres and dirt in the washing machine by means of a sealing device according to the invention. The sealing device is positioned in the annular space between the shaft 2 and the stationary portion 4. The sealing device consists of a sealing ring 8 and an annular element 10 having in axial section an angular profile.

The sealing ring 8 consists of elastic material, preferably rubber, and comprises a main body 12 and a sealing lip 14 unitary therewith. The sealing ring 8 is in a tensioned state positioned on a cylindrical surface 16 of the shaft, and before the sealing ring 8 is positioned on the cylindrical surface 16 the sealing ring has an inner diameter which is less than the outer diameter of the cylindrical surface 16. At its radially outer surface the main body 12 of the sealing ring 8 has two annular sealing lips 18 extending radially outwards. Between the sealing lips 18 the main body is provided with an identification text, i.e. giving information about the dimensions of the sealing ring.

The cylindrical surface 16 of the shaft 2 on which the sealing ring 8 is supported in a tensioned state forms at the left portion in fig. 1 a surface of an annular groove 22 which is thus constituted by two concentric side surfaces 24 and 26 and a bottom surface 28 extending therebetween. The main body 12 of the sealing ring 8 is received in the annular groove 22 with the radially inner bottom surface of the main body 12 contacting the side surface 24, the sealing lips 18 contacting the side surface 26 and the opposite surface of the main body 12 in relation to the sealing lip 14 of the sealing ring 8 contacting the bottom surface 28 of the groove. The distance between the side surfaces 24 and 26 is such in relation to the radial size of the main body 12 of the sealing ring 8 that the sealing lips 18 are resiliently deflected when the main body 12 of the sealing ring 8 is introduced in the groove 22.

The existence of the sealing lips 18 facilitates the introduction of the main body 12 into the groove 22 by the fact that the air trapped in the groove inside the main body of the sealing ring can leave the groove by purging out past the sealing lips 18 before the main body of the sealing ring reaches the bottom surface 28. The sealing lips 18 also provide that the tolerance requirements in respect of the distance between the side surfaces 24 and 26 of the groove and the dimensions of the main body 12 of the sealing ring are substantially less than if the sealing lips 18 are not present so that the outer peripheral surface of the main body 12 has to contact the side surface 26 directly.

The annular element 10 consists of a ring 30 of metal or another rigid material, the ring having an angular profile and an elastic material element 32 partly enclosing the ring. The annular element 10 is fastened to a cylindrical surface 34 of the stationary portion 4 and is positioned in relation to the sealing ring 8 so that an exposed surface of the ring 30 forms a counterface 36 engaged by the sealing lip 14 of the sealing ring 8. Thus, the sealing ring 8 and the annular element 10 cooperate so as to seal the annular space between the shaft 2 and the stationary element 4 so that the bearing 6 is protected against water, detergents, fibres and dirt in the washing machine.

Preferably the ring 30 consists of stainless steel and the ring 30 and the elastic element 32 are chemically bound to each other.

When the shaft 2 is rotated the sealing lip 14 of the sealing ring slides against the counterface 36 of the ring 30 producing a substantial amount of frictional heat at high rotational speeds, for example during the spinning or centrifugation cycle of the washing machine. If this heat is not carried off in an effecient way the temperature of the ring 30 and the sealing lip 14 is raised to a value which leads to damages or even destruction of the sealing lip 14 so that the sealing effect is deteriorated or even ceases.

In accordance with an embodiment of the invention the elastic element 32 is manufactured from graphitic nitrile rubber containing at least 20 % graphite by weight. This provides the annular element 10 with a good capacity to lead off the frictional heat to the stationary portion 4 in which the annular element 10 is fastened so that the rise of temperature of the ring 30 is kept at acceptable values also at high rotational speeds of the shaft 2.

It can be mentioned that the generation of frictional heat can be reduced by manufacturing at least the portion of the sealing lip 4 engaging the

counterface 36 from chlorinated rubber.

With regard to the forming of the sealing lip 14 of the sealing ring 8 it can also be mentioned that it advantageous to cut out the sealing lip so as to obtain an optimal sealing efficiency between the sealing lip and the counterface 36. The cutting reduces the risk of such effects which can be found in sealing rings in which the lip has been manufactured by moulding. It is suitable that the angle between the front surface of the sealing lip and the surface defining the periphery of the lip is about 90°.

Figs. 2a, 2b and 2c show different embodiments of the sealing ring of the sealing device according to the invention. In the embodiment according to fig. 2a the outer peripheral surface of the main body of the sealing ring has two annular projections in the form of sealing lips having a triangular cross sectional shape. An identification text 20 is provided between the sealing lips.

According to fig. 2b the sealing ring has at the surface of the main body in question only one sealing lip having the same cross sectional shape as the sealing lips of the sealing ring according to fig. 2a. The identification text is provided at one side of the sealing lip.

In fig. 2c there is shown an embodiment of the sealing ring in which said surface of the main body has only one annular projection having the form of a compression seal instead of a lip seal. Also in this embodiment the identification text is positioned at one side of the projection.

The invention can be modified within the scope of the following claims.

Claims

1. A sealing device for sealing an annular space between two machine elements (2, 4) which are rotatable in relation to each other, comprising an elastic material sealing ring (8) consisting of a main body (12) sealingly and unrotatably, at least partially received in a groove (22) in one of the machine elements (2) and a sealing lip (14) unitary with the main body, contacting a counterface (36) unrotatably supported by the other machine element (4) and sliding against the counterface when the machine elements are rotated in relation to each other, **characterized** in that the main body (12) of the sealing ring has at at least one of two side surfaces of the groove at least one annular projection (18) contacting the opposite side surface of the groove.

2. A sealing device according to claim 1, **characterized** in that the projection (18) is constituted by an elastically flexible sealing lip.

3. A sealing device as claimed in claim 1, **characterized** in that the projection (18) is constituted by an elastically compressible projection.

4. A sealing device according to any of the preceding claims, **characterized** in that the groove (22) is open in the axial direction, that the sealing ring (8) is positioned on a cylindrical surface (16) in a tensioned state, said cylindrical surface forming the radially inner side surface (24) of the groove, that the projection (18) is positioned at and engages the radially outer side surface (26) of the groove and that the sealing lip (14) is in the axial direction engaging the counterface (36) extending in the radial direction.

5. A sealing device according to any of the preceding claims, **characterized** in that it comprises an element unrotatably supported by the other machine element (4) and consisting of a portion (30) consisting of a rigid material, preferably metal, and forming said counterface and an elastic material portion (32) connected with a portion forming the counterface and with the other machine element and positioned therebetween.

6. A sealing device according to claim 5, **characterized** in that the elastic material (32) consists of graphitic nitrile rubber.

7. A sealing device as claimed in claim 6, **characterized** in that the graphitic nitrile rubber contains at least 20 % graphite by weight.

8. A sealing device as claimed in any of claims 5 - 7, **characterized** in that the portion (30) consisting of rigid material and forming the counterface is chemically bound to the elastic material portion (32) of the element unrotatably supported by the other machine element (4).

Fig.1.

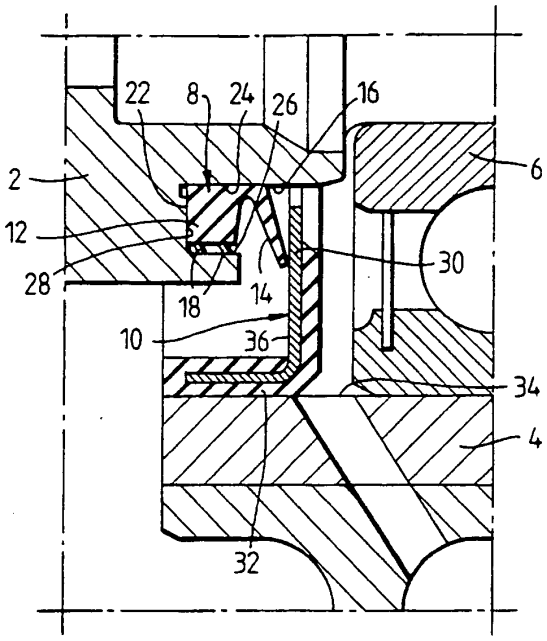


Fig.2a.

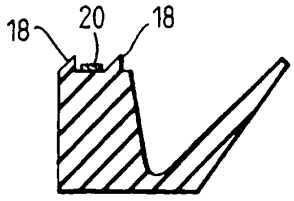


Fig.2c.

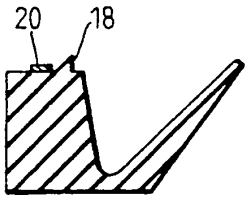
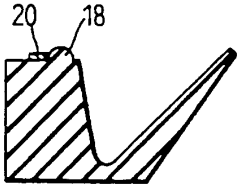


Fig.2b.



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EUROPEAN SEARCH REPORT

Application Number

EP 91 20 0597

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
Y	EP-A-0 137 144 (GARLOCK) * figures 1-7; page 6, paragraph 4 *	1,3-5	F 16 J 15/32
Y	US-A-4 596 054 (MACKENDRICK et al.) * figures 4,5; column 4, lines 38-49 *	1,3-5	
A	US-A-2 727 769 (KAYSER) * figures 4,5; column 2, lines 25-36 *	1,2	
A	US-A-4 252 329 (MESSENGER) * figures 1-4; column 3, lines 12-27 *	1,3,5	
A	US-A-4 283 063 (PRESCOTT) * figures 1,2; column 2, lines 11-30 *	1,3,5	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5) F 16 J

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
Berlin	06 August 91	THOMAS C L

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